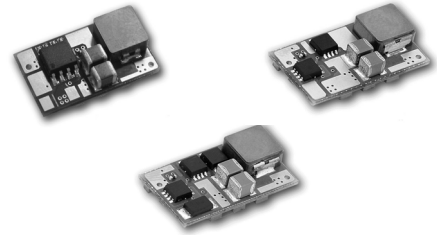


■ Information

The BST04M series is a small, thin, highly efficient and low noise non-isolated type step down DC-DC converter with 5V input that has been developed for distributed feeding. Output voltage is adjustable from 0.7525V to 3.63V and it can operate up to 85°C of the ambient temp with a minimal derating.



■ Features

- Small and thin type
W=20.3 L=11.4 H=5.35mm
- Non-Isolated type
- SMD
- High efficiency 93.5%, 90.0%
- Adjustable output voltage
- ON/OFF control
- Under voltage lockout
- Over current protection
- No electrolytic capacitor
- Long life, high-performance, low price
- Operating temp
-40°C to +85°C
(Temp derating required)
- Heatsink not required
- RoHS compliance

■ Model/Rating

Model BST04M Series	Input V Vdc	Output V Vdc	Output I A	Line Reg. % (typ.)	Load Reg. % (typ.)	Noise mVpp (typ.)	Efficiency % (typ.)
BST04M-0.7S06PDM	2.4 - 5.5	0.7525-3.63	0 - 6.0	0.6	1.0	40	93.5
BST04M-0.7S10PDM			0 - 10.0				90.0

Table 1

Note1: Ripple noise and efficiency are when input voltage is 5V, output voltage 3.3V and output current is rated.
 Note2: Ripple noise is measured by 20MHz bandwidth with a multi layered ceramic capacitor.
 BST04M-0.7S06PDM : 47µF×4 at input, 47µF×2+1µF at output
 BST04M-0.7S10PDM : 47µF×6 at input, 47µF×4+1µF at output
 Note3: Depending on ambient temp conditions, cooling air flow may be required.

■ Specifications

Table 2

Models	BST04M-0.7S06PDM	BST04M-0.7S10PDM	Conditions
Input voltage range	2.4 to 5.5V (Vout ≤ 1.8V) 3.3 to 5.5V (Vout ≤ 2.5V) 4.5 to 5.5V (2.5V < Vout)		Support all adjustable range for output voltage
Rated input voltage	5.0V		
Output voltage anomaly	± 1.5% (Output voltage : 0.7525V)		Trim pin Open , Output current 0A
Adjustable output voltage range	0.7525 to 3.63V		0.7525V for the default setting
Line regulation	0.6% typ.		Input voltage varying from 2.4 to 5.5V
Load regulation	1.0% typ.		Load varying from 0 to 100%
Total regulation	± 2.5% max.		Inclusive of output voltage anomaly, line, load and temp regulations
Ripple noise	40mVp-p typ.		Output voltage 3.3V, Measurement frequency bandwidth 20MHz
Efficiency	93.5% typ.	90.0% typ.	Input voltage 5V, Output voltage 3.3V, Rated output current
	78.0% typ.	70.3% typ.	Input voltage 5V, Output voltage 0.7525V, Rated output current
Over current protection	Activated at 9.6A typ. A hick-up mode, Auto-recovery	Activated at 16.5A typ. A hick-up mode, Auto-recovery	Output voltage 3.3V
Over voltage protection	No		
Under voltage lockout	Yes		
Over current protection	No		
Remote ON/OFF control	Between 5 pin (On/Off) and 2 pin (GND) : Output ON when in Open, Output OFF when in Short (Refer to P.8)		
Standby Current	2.0mA typ.		
Remote sensing	No		
Max output load capacity	2000µF max (ESR>10mΩ), 1000µF max (ESR>1mΩ)		
Operating temp range	-40°C to +85°C (Refer to the separate temp derating chart)		
Humidity range	20 to 85% R.H. (No condensation)		
Storing temp range	-55°C to +125°C		
Storing conditions	Before mounting a converter : 30°C/60% R.H. or lower with less than 1 year (After opening moisture-proof packaging)		
Cooling conditions	A cooling air flow may be required depending on the ambient temp. Refer to the separate derating chart.		
Weight	2.2g typ.	2.4g typ.	
Dimensions	W=20.3 L=11.4 H=5.35 typ. (mm) *For further details, please refer to Page 5.		

*The above information is stated with rated value at 25°C of normal temp, unless otherwise specified.

1. Usage range

The datasheet applies to a direct input, non-isolated type DC-DC converter, BST04M Series.

2. Model name/Rating

Table 3

Models	Rated input voltage	Output voltage	Rated output current	Shapes
BST04M-0.7S06PDM	DC 5.0V	0.7525V to 3.63V	6A	SMD
BST04M-0.7S10PDM			10A	

The default setting of output voltage is $0.7525V \pm 1.5\%$.

Input/output is rated with the ambient temp $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$, unless otherwise specified in the datasheet.

3. Environmental conditions

3-1. Temp range

Active -40°C to $+85^{\circ}\text{C}$ (Temp derating required, refer to section 9)

Storage -55°C to $+125^{\circ}\text{C}$

3-2. Humidity range

Active 20 to 85%RH (No condensation)

Storage 5 to 85%RH (No condensation)

4. Specification/Rating

The product complies with RoHS.

4-1 Absolute maximum rating

Absolute maximum rating is the rating when the product is overworked. Excessive stress to the product can cause permanent damage. If the product is used under the absolute maximum rating for a long period of time, the credibility of the product could be damaged. Therefore, please use the product under the conditions specified in the electrical characteristics chart [4-2].

Table 4

Items	code	min.	max.	units
Input voltage	Vin	-0.3	6.0	V
Output voltage	Vout	0.7525	3.63	V
Operating temp range	Ta	-40	85	$^{\circ}\text{C}$
Storing temp	Tstg	-55	125	$^{\circ}\text{C}$

4-2. Electrical characteristics

4-2-1. Electrical characteristics BST04M-0.7S06PDM

(Ta=25°C, Airflow=200LFM(1.0m/s), Vin=5.0V, Vout=0.7525-3.63V, Io=Rated, unless otherwise specified in the conditions)

Table 5

Item	Code	Conditions	min.	typ.	max.	Units
Input characteristics						
Input voltage range	Vin	Vout = 1.8V	2.4	5.0	5.5	V
		Vout = 2.5V	3.3	5.0	5.5	V
		2.5V < Vout	4.5	5.0	5.5	V
UVLO turn-on voltage			2.2	2.4	V	
UVLO turn-off voltage			1.95	2.1	V	
Max input current	Iin	Vin = 2.4V Vout = 1.8V Io = 6.0A			5.02	A
Input current at no-load	Iin	Vout = 3.3V Io = 0A		53		mA
Standby current	Iin			2.0		mA
Recommended input capacity	Cin	47μF × 4 min.	188		1200	μF
Output characteristics						
Output voltage setting anomaly	Vout	Vin = 5.0V Io = 0A	-1.5	Vout	+1.5	%Vout
Adjustable output voltage range	Vout		0.7525		3.63	V
Line regulation		Vin = 2.4V ~ 5.5V Io = 6.0A		0.6		%Vout
Load regulation		Io = 0A ~ 6.0A		1.0		%Vout
Total regulation		Inclusive of output voltage setting anomaly, input, load, temp regulations	-2.5		+2.5	%Vout
Output current (Temp derating required)	Io		0		6.0	A
Over current protection	Io	Vout = 3.3V		9.6		A
Output overshoot at turn-on		Remote ON / Input ON			2	%
Recommended output capacity	Co	47μF × 2 min.	94			μF
Max output load capacity	Co	ESR > 1mΩ ESR > 10mΩ			1000 2000	μF
Output ripple noise						
Vout = 3.3V		Bandwidth = 20MHz Cin = 47μF×4, Cout = 47μF×2+ 1μF		40	70	mVp-p
Efficiency						
Vo = 3.3V Vo = 1.8V Vo = 0.7525V	η	Vin=5.0V Io=6.0A		93.5 89.0 78.0		%
Others, features and characteristics						
Switching frequency				300		kHz
Remote ON/OFF control Logic High Voltage Logic Low Voltage		Module On, Von/off Module Off, Von/off	Vin-0.8 -5.0		Vin Vin-1.6	V V
Overheat protection				120		°C
Weight				2.2		g

4-2-2. Electrical characteristics BST04M-0.7S10PDM

(Ta=25°C, Airflow=200LFM(1.0m/s), Vin=5.0V, Vout=0.7525-3.63V, Io=Rated, unless otherwise specified in the conditions)

Table 6

Items	Code	Conditions	min.	typ.	max.	Units
Input characteristics						
Input voltage range	Vin	Vout = 1.8V	2.4	5.0	5.5	V
		Vout ≤ 2.5V	3.3	5.0	5.5	V
		2.5V < Vout	4.5	5.0	5.5	V
UVLO turn-on voltage			2.2	2.4	V	
UVLO turn-off voltage			1.95	2.1	V	
Max input current	lin	Vin = 2.4V Vout = 1.8V Io = 10A			8.95	A
Input current at no-load	lin	Vout = 3.3V Io = 0A		45		mA
Standby current	lin			2.0		mA
Recommended input capacity	Cin	47μF × 6 min.	282		1200	μF
Output characteristics						
Output voltage setting anomaly	Vout	Vin = 5.0V Io = 0A	-1.5	Vout	+1.5	%Vout
Adjustable output voltage range	Vout		0.7525		3.63	V
Input regulation		Vin = 2.4V ~ 5.5V Io = 10A		±0.3		%Vout
Load regulation		Io = 0A ~ 10A		±0.5		%Vout
Total regulation		Inclusive of output voltage setting anomaly, input, load, temp regulations	-2.5		+2.5	%Vout
Output current (Temp derating required)	Io		0		10.0	A
Over current protection	Io	Vout = 3.3V		16.5		A
Output overshoot at turn-on		Remote ON / Input ON			2	%
Recommended output capacity	Co	47μF × 4 min.	188			μF
Max output load capacity	Co	ESR > 1mΩ ESR > 10mΩ			1000 2000	μF
Output ripple noise						
Vout = 3.3V		Bandwidth = 20MHz Cin = 47μF×6, Cout = 47μF×4+1μF		40	80	mVp-p
Efficiency						
Vo = 3.3V Vo = 1.8V Vo = 0.7525V	η	Vin=5.0V Io=10A		90.0 85.0 70.3		%
Others, features and characteristics						
Switching frequency				300		kHz
Remote ON/OFF control						
Logic High Voltage		Module On, Von/off	Vin-0.8		Vin	V
Logic Low Voltage		Module Off, Von/off	-5.0		Vin-1.6	V
Overheat protection				120		°C
Weight				2.4		g

4-3. Measurement circuits

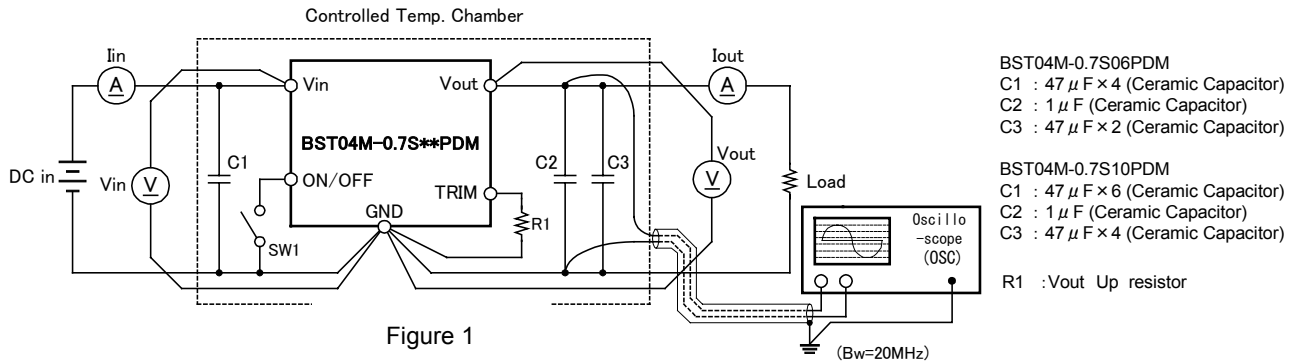


Figure 1

5. Outer dimensions and pin information

5-1. Configurations/Dimensions

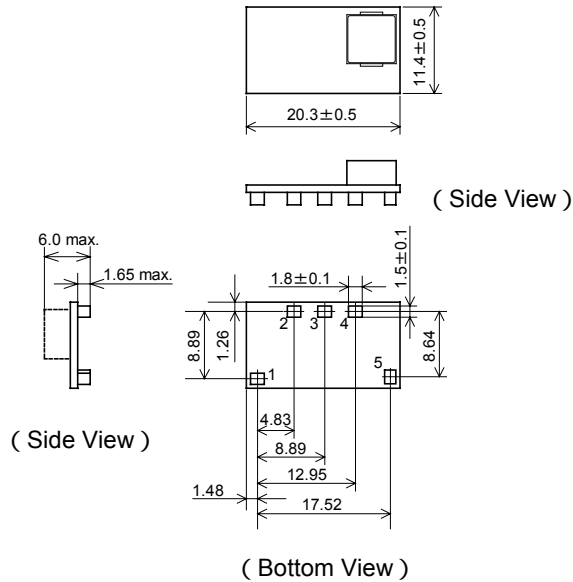


Figure 2

Table 7

Pin	Name	Function
1	Vin	+ Input pin
2	GND	Input/output GND pin
3	TRIM	Adjustable output voltage pin
4	Vout	+ Output pin
5	ON/OFF	Remote ON/OFF control pin

Pin numbers are not indicated on the product.

Pin material : Copper
 Coat on the pins : Gold plate after plated with Nickel

- Units mm
- Tolerances unless otherwise specified ± 0.25
- Weight = 2.2g typ.
 (BST04M-0.7S06PDM)
 = 2.4g typ.
 (BST04M-0.7S10PDM)

5-2. Recommended pad dimension diagram

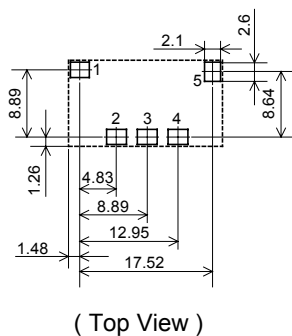


Figure 3

5-3. Model name/Year and Month of manufacturing display

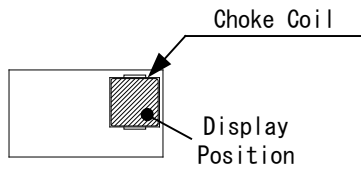


Figure 4

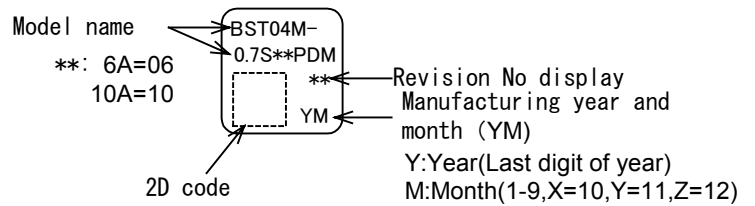


Figure 5

6. Usage

6-1. Standard connection circuit

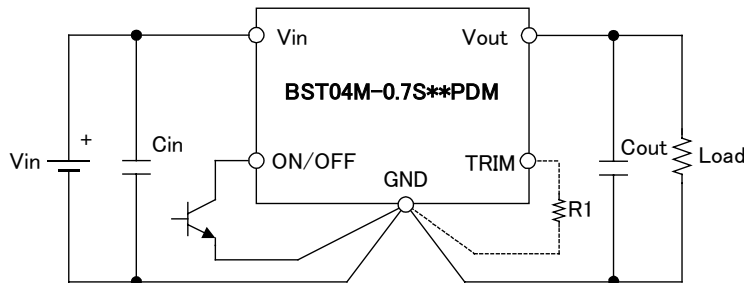


Figure 6

BST04M-0.7S06PDM
 Cin : 47 μ F \times 4 (Ceramic Capacitor)
 Cout : 47 μ F \times 2 + 1 μ F (Ceramic Capacitor)
 BST04M-0.7S10PDM
 Cin : 47 μ F \times 6 (Ceramic Capacitor)
 Cout : 47 μ F \times 4 + 1 μ F (Ceramic Capacitor)
 R1 : Vout Up Resistor

6-2. Input filter

Input power supply to the BST04M series should be provided with low impedance. High impedance on the input side may cause some stability issues to the module. Therefore, an added capacitor (Cin) requires a low ESR capacitor. If a ceramic capacitor is used as a low ESR capacitor, the use of the capacity and number of pieces indicated in the standard connection circuit [6-1] should be recommended. When impedance on the input side is especially high, such as long wiring, capacitors other than the recommended capacitors are required to be added. The capacitor (Cin) should be connected near to the module. When several converters with the switching method operate with the same electrical power source or by a cascade connection, they interact with each other and will have an effect of beat frequency that could appear in output voltage or a beat sound. When using these connections, L-C filters need to be made.

6-3. Remote ON/OFF control

Output voltage may be controlled by ON/OFF feature without switching on and off the input. The ON/OFF pin is pulled-up by V_{in} inside the module. When not using the ON/OFF control, leave the ON/OFF pin open or connect to V_{in} .

Between ON/OFF (5pin) and GND (2pin)

OPEN : Output ON

SHORT : Output OFF

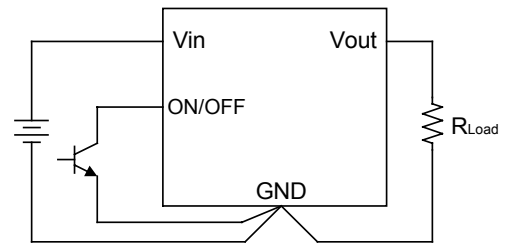


Figure 7

A device used for the ON/OFF control should have a sink capability of around 0.4mA in the Low level.

6-4. Output voltage programming

The BST04M series may adjust to any output voltage within the range of 0.7525V to 3.63V.

Please note that the input voltage range may vary depending on the output voltage. Please refer to the electrical characteristics [Section 4-2].

When the TRIM pin is open, the output voltage is $0.7525V \pm 1.5\%$.

There are two methods to adjust output voltage. One is by an external voltage and the other is by an external resistive connection.

6-4-1. Adjustable methods by an external voltage

Output voltage, V_{out} may be adjusted by applying an external voltage between the TRIM and GND pins as in Figure 8.

The output voltage, V_{out} may vary to slight change of V_{CTRL} voltage with only external power supply of V_{CTRL} ($R_{EXT}=0\Omega$).

Connecting a resistor, R_{EXT} between the TRIM pin and the external power supply in series should be recommended to prevent this

The formula for the adjustable external voltage V_{CTRL} of the BST04M series is as follows.

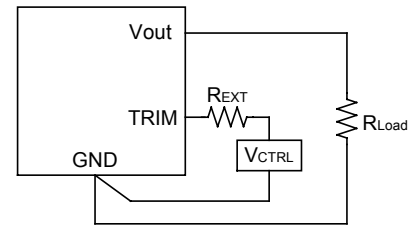


Figure 8

$$V_{CTRL} = 0.7 - \frac{(5.11 + R_{EXT})(V_{out} - 0.7525)}{30.1} [V]$$

e.g.) The formula of V_{CTRL} for setting V_{out} to 3.3V ($R_{EXT}=15k\Omega$) is as follows.

$$V_{CTRL} = 0.7 - \frac{(5.11 + 15)(3.3 - 0.7525)}{30.1} = -1.002V$$

E.g. for voltage control

Table 8

Vout (V)	VCTRL (V)	
	R _{EXT} =0Ω	R _{EXT} =15kΩ
0.7525	OPEN or 0.700	OPEN or 0.700
1.0	0.658	0.535
1.2	0.624	0.401
1.5	0.573	0.201
1.8	0.522	0.000
2.0	0.488	-0.133
2.5	0.403	-0.468
3.3	0.268	-1.002
3.63	0.212	-1.223

6-4-2. Adjustable methods by an external resistor

Output voltage, V_{out} may be adjusted by connecting a resistor between the TRIM and GND pins as in Figure 9.

The formula for the adjustable resistor, R_{TRIM} of the BST04M series is as follows.

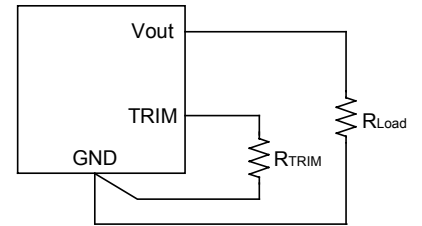


Figure 9

$$R_{TRIM} = \frac{21.07}{(V_{out} - 0.7525)} - 5.11 [k\Omega]$$

e.g.) The formula of R_{TRIM} for setting V_{out} to 3.3V is as follows.

$$R_{TRIM} = \frac{21.07}{(3.3 - 0.7525)} - 5.11 = 3.16k\Omega$$

After working out the external resistance, make sure to check the output voltage and adjust the resistance value. The tolerances of R_{TRIM} will affect to the tolerances of the output voltage.

e.g. for adjustable resistance control

Table 9

Vout (V)	R _{TRIM} [kΩ]	Approximate value of R _{TRIM} when using the resistor in THE E96 line [KΩ] *
0.7525	OPEN	—
1.0	80.02	80.6
1.2	41.97	42.2
1.5	23.08	23.2
1.8	15.00	15.0
2.0	11.78	11.8
2.5	6.95	6.98
3.3	3.16	3.16
3.63	2.21	2.21

*There may be a slight difference in V_{out} value because of the approximate values.

7. Overheat protection

When the BST04M series is used under adverse condition, it will go into the overheat state and stop operating automatically. When the temperature goes back to normal, it will recover itself. (Auto-reset).

8. Over current protection

The converter protects itself against over current and short circuits. When it goes into the over heat state, it will go into the pulse-by-pulse and hick-up modes. When the over current state is released, the output voltage will go back to normal. (Auto-reset). Please refrain from using the product for a long period of time under the over current or load circuit conditions that could result in damaging the converter.

9. Temperature derating

Although the converter will operate in a wide range of temperatures, a cooling airflow will be required to release heat when the ambient temp is high.

Please refer to Page 10 in regards to the temp. derating curve that will support the thermal design to use the converter properly.

Measuring in the actual usage environment will be recommended for certain cooling. Especially, when the load in the actual use is close to maximum value of the temp derating, the measurement is required. Make sure that the parts temperatures do not exceed 120°C when used. Figure 10 shows the appropriate parts when measuring temperatures.

Figure 12 to 17 show the max output current under the conditions of the designated environmental temperature and air-cooling. The product is placed horizontally and the wind direction is as in Figure 11.

The air-cooling condition is 100LFM 0.5m/sec.

[Maximum output current]

The value of maximum output current under given conditions will be either 1) or 2), whichever the current value is smaller.

- 1) Output current when the temperature of any parts reaches to 120°C
- 2) The official rated current value of the converter

[Measurement condition]

The temp. derating curve will be defined under the following conditions.

Board : Size 110 x 100mm, t1.6, 4 layers (Copper foil inner layer 70μF, outer layer 70μF)

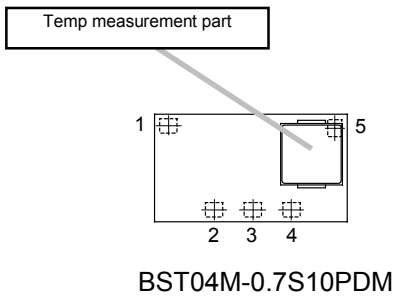
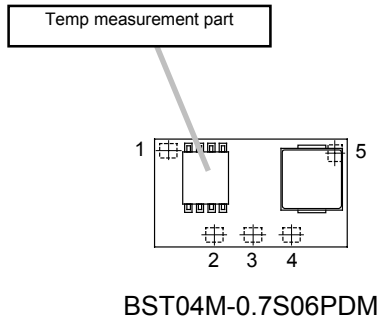
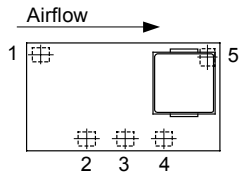


Figure 10. Temp measurement point



BST04M-0.7S06PDM, BST04M-0.7S10PDM

Figure 11. Temp derating air-cooling direction

9-1. BST04M-0.7S06PDM Temp derating curve

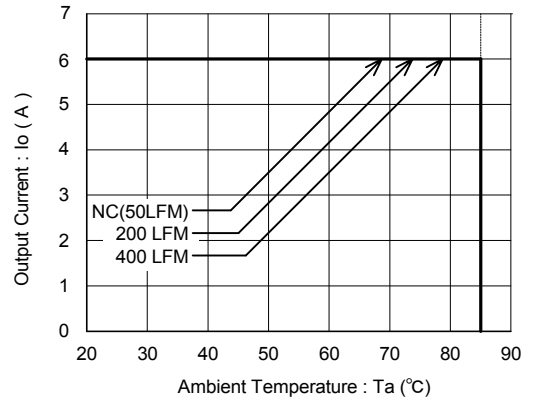


Figure 12. BST04M-0.7S06PDM ($V_{in}=5.0V$, $V_o=3.3V$)

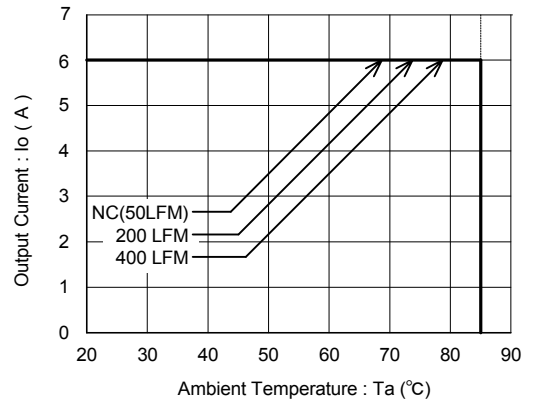


Figure 13. BST04M-0.7S06PDM ($V_{in}=5.0V$, $V_o=1.8V$)

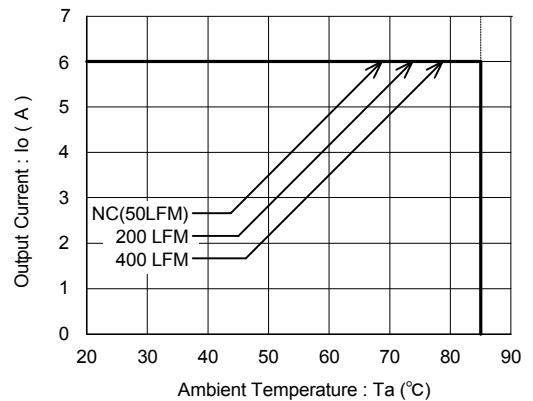


Figure 14. BST04M-0.7S06PDM($V_{in}=5.0V$, $V_o=0.7525V$)

9-2. BST04M-0.7S10PDM Temp derating curve

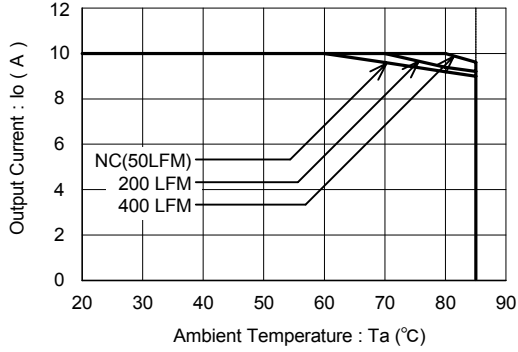


Figure 15. BST04M-0.7S10PDM (Vin=5.0V, Vo=3.3V)

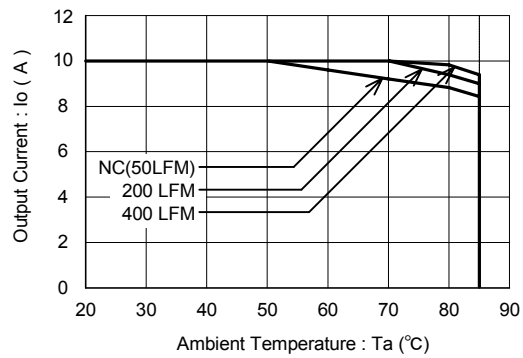


Figure 16. BST04M-0.7S10PDM(Vin=5.0V, Vo=1.8V)

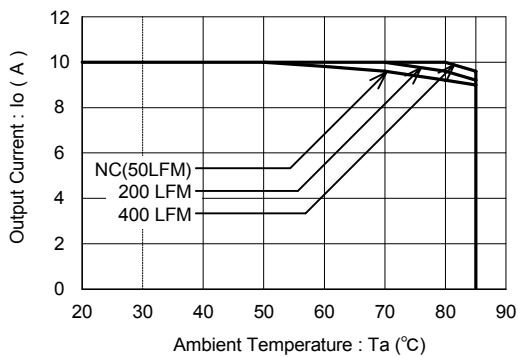


Figure 17. BST04M-0.7S10PDM(Vin=5.0V, Vo=0.7525V)

10. Protection method of input power supply against reverse connection

The product is a non-isolated type between input and output and step down converter from a straight polarity to a straight polarity. It will be damaged if input polarity is connected in reverse. When there is a possibility of reverse connection, please add a protection circuit as in the below figure.

The below figure is an example of using fuse and diode. The power supply on the supply side should have enough capacity to meltdown a fuse.

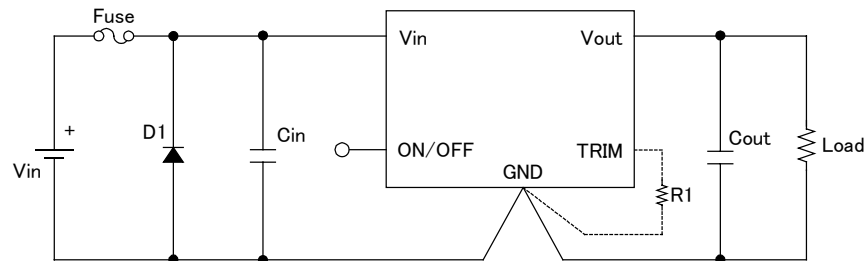


Figure 18

11. Over voltage protection (Example)

The product does not have over voltage protection built in.

When the product is damaged due to the short mode in the internal switch element, the DC input voltage will appear in output as is. Therefore, just in case the over voltage mode will be damaged, please add the input shutoff circuit as in the below figure.

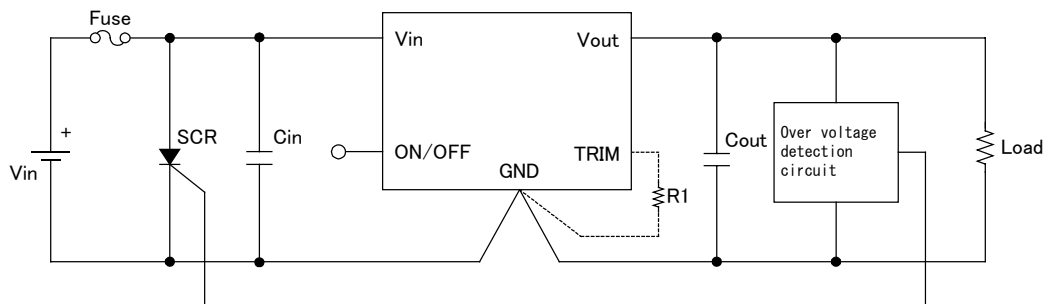


Figure 19

*1 When the product is damaged due to the over voltage mode, the ON/OFF control will not function.

*2 When there is ON/OFF control on the electrical supply side, over voltage protection circuit will be used.

*3 The DC power supply on the electrical supply side should have enough capacity to meltdown a fuse.

12. Mounting conditions

The product may be soldered by the re-flow method. Make sure not to cause the product to vibrate during the re-flow.

This product can not be soldered on by flow. The number of re-flows is twice.

The re-flow temp profile is as follows (Figure 20).

The number of re-flow will be limited to twice.

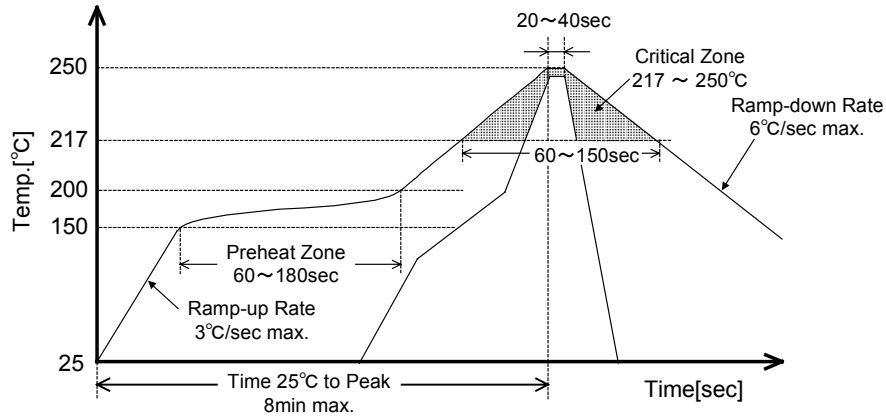


Figure 20. Re-flow temp profile (lead-free product)

13. About washing

The product can not be washed as a whole, although a non scrub flux is recommended.

14. Precautions

For the safety of our customer, please follow all warnings and specifications which are stated below.

- This product is intended for use in general electronic appliances (office work machines, telecommunication equipment, and measurement equipments). Do not use for medical equipments, nuclear power equipments, and trains, etc. where the malfunction and damage of this product may directly cause harm to human life and/or property. Please confirm when using except in general electronic equipment.
- For this product, serial and parallel operations are not possible.
- For mounting this product, please do not use connectors or sockets. The performance may not be fulfilled by the effect of contacting resistors. Mount onto the PCB by soldering.
- This product has a built-in over current, short circuit protection, however long time usage in short circuit should be avoided since this may cause failure to the product.
- This product may be damaged if used under nonstandard electric and environmental conditions such as the temperature. Please be sure to always use within the standard conditions.
- Please refrain from using and storing the product where corrosive gas may be generated. Dust may cause problems so store in a dust free environment.
- There is a possibility that the product may be damaged from static electricity. The workers should discharge all static electricity before handling the product, and the work atmosphere should also have a static countermeasure.
- This product does not have a fuse built in. When abnormal, please connect a fuse into +input line as a protection of over current. The electrical supply source should have enough capacity to be able to shut down a fuse.
- This product does have a built-in over voltage protection, however when the module malfunctions and over voltage occur, the over voltage protection installed will not activate. Therefore, an over voltage protection circuit should always be connected.
- No test certificate is attached to this product.

15. Warranty

The warranty period for this product is one year. If any defects occur in which our company's design or production is to blame during the period, we will either fix the product or trade with a new one, free of charge.

However, the warranty is voided if the product has been internally modified or adjusted.

The warranty covers only the stated products in this datasheet.

16. If you have any further technical questions for this product, please contact us.

E-mail: info@bellnix.com

<http://www.bellnix.com>